

# Tutorial on Cellular Automata and Tilings

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## Abstract

Cellular automata (CA) are massively parallel systems where a regular grid of finite symbols is updated according to a synchronous application of the same local update rule everywhere. A closely related concept is that of Wang tiles where a local relation between neighboring symbols determines allowed combinations of symbols in the grid. In this tutorial we start with classical results on cellular automata, such as the Garden-of-Eden theorems, the Curtis-Hedlund-Lyndon-theorem and the balance property of surjective cellular automata. We then discuss Wang tiles and, in particular, the concept of aperiodicity and the undecidability of the domino problem. The domino problem is the decision problem to determine if a given Wang tile set admits any valid tilings of the grid. We relate Wang tiles to cellular automata, and establish a number of undecidability results for cellular automata.

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